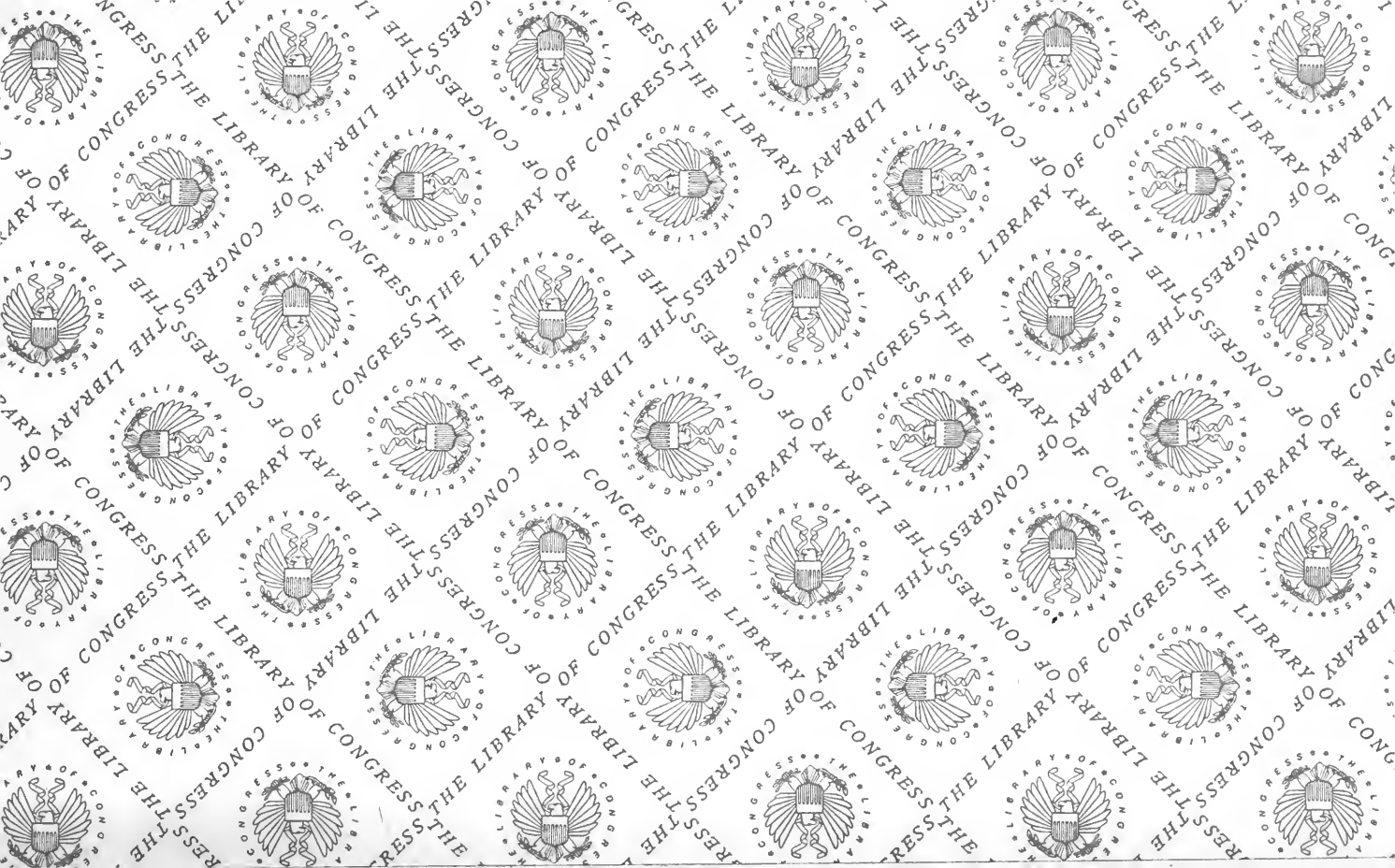
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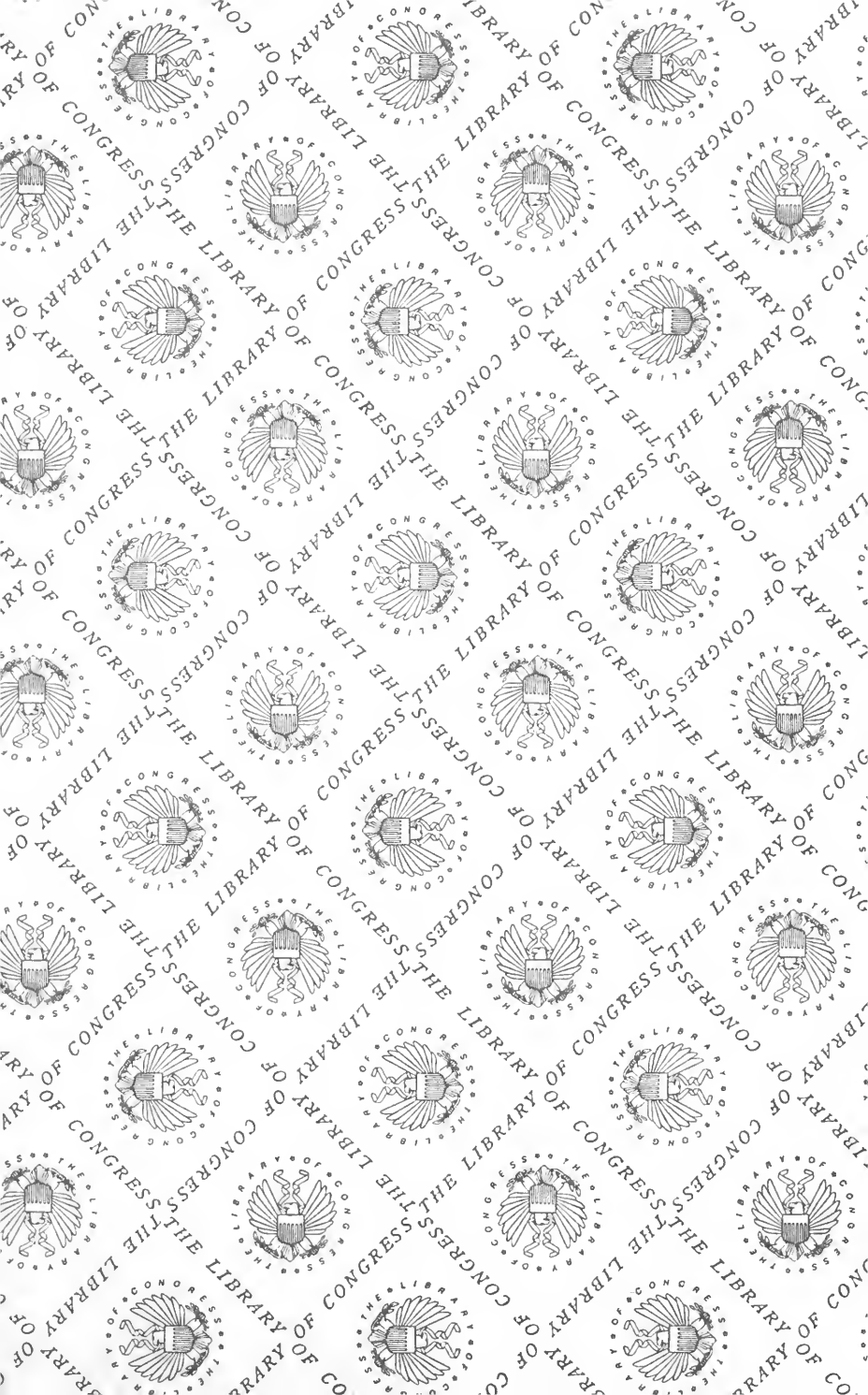
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THE UNDERWRITERS' BUREAU
OF NEW ENGLAND
93 WATER STREET, BOSTON

REPORT No. 118

ON

The Chelsea Conflagration

of April 12, 1908

Report by Winthrop P. Tenney, Benjamin Richards, John W. Chapman and Gorham Dana

Photographs by W. P. Tenney, G. Dana, J. Dana

Plan drawn by Isabel Worthington

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Fig. 1. General view of conflagration from the northwest, about 11.30 A. M.

The Chelsea Conflagration

ON Sunday, April 12, 1908, Chelsea, Mass., was visited by a conflagration which destroyed approximately one-half the improved area of the City. About thirty-five hundred buildings were burned, covering an area of nearly two hundred and seventy-five acres. Up to the present time, eighteen persons are known to have perished and it is believed that the total loss will prove to be over twenty lives. The monetary loss was some twelve millions of dollars and the insurance loss was a little over nine millions.

This report seeks to give an accurate account of the underlying causes that made such a catastrophe possible, to trace the development of the fire from inception to control and to draw conclusions which it is hoped will be of value. Students of fire protection engineering will find in the Chelsea fire little of scientific interest but municipal authorities might profit by the lessons it teaches.

Description of the City

At the time of the fire, Chelsea was a city of about thirty-eight thousand inhabitants of which probably one-third were of foreign extraction. It had the regular city form of government, mayor, aldermen and the various municipal departments. During recent years, many influential citizens of means had moved away and the foreign element of low moral stamina and small earning capacity had steadily increased. Property had decreased in valuation. The city had been loaded down with heavy municipal expenses and tax returns were decreasing. The tax rate had increased. Chelsea had slowly deteriorated. A policy of the utmost economy was required. The municipal departments most necessary for protection against the danger of conflagration, the Fire, Building and Water Departments, were handicapped. Money actually needed for improvements was diverted to other channels. The maintenance and organization of these departments had not kept pace with the growth of the city.

All this time, the "rag district" had been increasing rapidly in area, number of buildings and population. Prominent rag dealers from all sections of the country were attracted to Chelsea until at the time of the conflagration it was the rag centre of this part of the country. There were in this "rag district," bounded by the railroad, Arlington and Williams Streets, about two hundred rag and junk collectors and dealers. There were probably at least fifty rag shops. Rag and junk collectors and dealers were required to have licenses but none were required for rag shops. In certain streets, nearly every shed, stable and yard contained rags. Vacant stretches of land were utilized for drying purposes, the rags being spread out all over the ground. Rags were even dried on lines in back yards. It seems as if little serious attempt was made to properly supervise these rag dealers in their pursuit of a livelihood, and by playing the game of politics they did

about as they chose. The consequence was that the district was a conflagration breeder of the worst kind. That these conditions were fully understood by the City officials and department heads it is only necessary to quote Mayor Willard's reference to the "rag district" in a report as long ago as January 1, 1907. He said, "When we consider that at any time with a high wind prevailing, a fire might gain such headway as to get beyond control.....and would destroy property worth many thousands of dollars, we realize that the cost does not enter into it as much as the protection of the property." Chelsea openly acknowledged a deplorable condition of affairs and yet nothing was done to improve it.

Character and Occupancy of the Buildings.

The "rag district" where the fire obtained its tremendous start was covered with small one to three-story frame buildings and shanties occupied principally as dwellings, stables and sheds, interspersed with two and three-story rag shops, tenements and junk shops. Here and there long rows of brick and frame dwellings extended up into the heart of the city. A large part of the buildings were of the cheapest and flimsiest construction. Approaching the business section, brick buildings predominated and on Broadway, the business centre, the buildings averaged higher and the construction, while better than in the outlying districts, was, on the whole, rather poor. These buildings were mostly two and three stories in height, very few being as high as four stories. Sheds and other frame structures extended close up to the rear of the unprotected Broadway buildings. Brick churches, schools, city buildings and frame synagogues were located throughout the entire area, some with considerable open space about them. This space proved entirely ineffective in stopping the progress of the fire. The centre of the city was, as a whole, closely built up and frame buildings predominated.

There were no fire resisting buildings throughout the burned area. The nearest approach to this seen was the building occupied by the Chelsea Trust Co. While not in any sense fire resisting, its walls were very nearly blank toward the conflagration and the bricks well laid and bonded. This building received a heavy part of the conflagration and although the interior was completely burned, the walls successfully withstood the flames, doubtless serving to some extent to prevent further progress of the fire to the southeast.

Beyond Broadway, on Bellingham Hill and vicinity, many of the dwellings, which occupied this section almost exclusively, were of an old type of two and one-half-story cottage house. The frame ones had pitch shingle roofs while many of the brick ones had outside accessory woodwork. Probably seventy-five per cent. of this section was of frame construction. On the outskirts of this part but more widely separated and skirting the water front were several specially hazardous occupancies such as oil and varnish works and a lampblack and stain factory.

Viewed as a whole, structural conditions in the conflagration area were very poor, the buildings being mostly of wood with many concealed spaces, inflammable roofs, boxed cornices and a notable lack of parapet walls and protected windows.

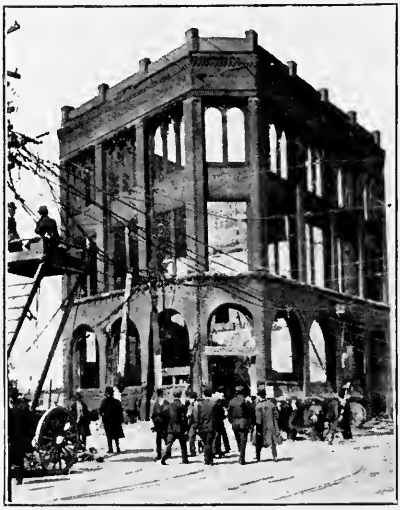


Fig. 2. The Chelsea Trust Co. building

Fire Department and Water Supply

The Chelsea Fire Department consisted of twenty-one permanent and fifty-seven call men divided into seven companies. There were three steamers and one chemical engine with hose and the ordinary equipment. All the apparatus responded to a second alarm. There were numerous cities and towns within a radius of ten miles that could give aid in case of a serious fire. There had been numerous fires in the "rag district" and the dangers of the locality were well understood. Soon after the fire was discovered, aid was summoned from Boston, Somerville, Cambridge, Malden, Melrose, Everett, Wakefield, Quincy, Newton, Revere and Lynn. In all, about thirty engines were in service during the fire.

The water supply was quite satisfactory for a city of this size. The normal pressure was about fifty pounds in the business section and the feed mains were of liberal size. There was a fair supply of hydrants, generally four to six hundred feet apart. Some of the newer portions of the "rag district" lacked hydrants but in other portions, hydrants were two hundred feet apart.

The details of the water supply will be described under a separate heading.

Fig. 3. Rag pile where fire started, in foreground Boston Blacking Co. buildings at left, Hecla Compress Gas Co. on right. Looking east

Causes of the Conflagration

The ignition of rags and waste in the rear of Second Street near the corner of Carter Street first started the fire. This section of the town at the extreme west was mostly open wet land in process of filling. The usual dumps and numerous rag shops were in evidence. There were great piles of cotton and yarn waste, also woolen rags spread over the ground to dry. In some way unknown, these were ignited, causing a smouldering fire which had probably been burning some time. The wind, which was very high, was unusually severe in this locality owing to the open stretch of flat country extending over the marshes toward Everett. The burning rags were blown against the "McKay" wax shop of the Boston Blacking Co. about two hundred feet distant, and set fire to it. Rags drying in the vacant space east of the Hecla Compress Gas Co.'s buildings next took fire and ten or fifteen minutes later the fire broke out in a large pile of rags inside Lewitsky's rag yard about nine hundred feet to the southeast of the blacking factory. It was at Lewitsky's and Rosenfield's rag shops adjoining each other on Third, Elm and Maple Streets, that the conflagration really started.

The fires in the Boston Blacking Co.'s building and in the vacant space east of the Hecla Compressed Gas Co.'s factory undoubtedly were due to rags or sparks from the original fire but there is some doubt as to whether the fire in Lewitsky's yard and building can be attributed to this cause. Incendiarism is openly charged and there are too many of these reports to doubt that in part they have some real foundation. The State Police are now investigating the matter. Burning rags may have been blown by the wind to Lewitsky's yard, if so, they must have passed over an enclosure containing tar paper storage and a two-story frame laundry on Maple Street.

The wind was very severe on this day; were it not for this fact the fire undoubtedly would have been controlled in its early stages. The maximum velocity of the wind at 9 o'clock was twenty-six miles an hour as recorded by the U. S. Weather Bureau at Boston. This had increased to thirty-six miles as a maximum at 1 o'clock. It is possible that on account of the configuration of the land on each side of Chelsea the severity may have been somewhat greater here, for a wind of twenty-six to thirty-six miles an hour is not extraordinary for this section. These conditions, together with the poor construction and hazardous occupancy of this section of the city were the principal causes for the fire getting beyond control.

Story of the Fire

The first fire started sometime after 10.30. First alarm was sounded at 10.45. The Fire Department on arriving proceeded leisurely to put a stream on the waste which was burning slowly, for the fire was then not at all serious. In about five minutes they noticed that the side of the Boston Blacking Co.'s building was also on fire and a second alarm was sounded at 10.55. This was more as a precautionary measure because of the high wind and the knowledge of the large amount of naphtha and rosin stored inside the yard. The Chief went at once to the Blacking Co.'s buildings and in about ten minutes had the fire well in hand. Some one then came to him with the story that the rags in Lewitsky's yard on the corner of Maple and Elm Streets, about nine hundred feet from the Boston Blacking Co.'s buildings were on fire. He despatched his chemical engine to this new fire. On arriving, the chemical man saw a brisk blaze in these rags, which were heaped up beside the rag shop. He was making progress and just considered that the blaze was practically under control when to his surprise, the fire flashed through the office inside the main building. Understanding the seriousness of this, he sent word to the Chief that this building was on fire inside and without waiting to investigate, the Chief sent a special call to Boston for two steamers. This was received at 11.25. Then rapidly followed telephone calls to Boston and neighboring towns for all the help possible. About twenty-five engines responded up to 1 o'clock.

Meanwhile, driven by the high wind, the fire rapidly spread throughout Lewitsky's and Rosenfield's rag shops, both three-story frame structures, and by the time the first Boston engine arrived, possibly 11.30, was well on its way to Arlington Street. It swept through the small frame buildings in these blocks with extraordinary rapidity passing onward by leaps and bounds, picking out shingle roofs and obtaining a foothold on porches and buildings far ahead. The panic of the inhabitants who sought to remove their furniture and bedding to places of safety also helped in no small degree the spread of the fire. Many loads of furniture took fire in the streets as did that stored on sidewalks and parks.

The Chief had requested the Boston engines on arriving to rally on Arlington Street where he hoped that several brick buildings would serve to check the flames. When the engines arrived, the fire had already passed the street in places and was making great strides toward

Broadway. It seemed impossible to stay its progress and the engines no sooner got in front of it than their position became untenable. By 12 o'clock it was passing Broadway near the junction of Washington Avenue and here a partial rally was made but nothing was gained and an engine had to be abandoned. By 12.30 it had crossed Broadway in

Fig. 4. View across Broadway Sq. about 4 P. M. during fire

many places and frame houses and sheds even as far in advance as Shawmut and Congress Avenues were on fire. It leaped whole blocks, reaching the American Circular Loom Co. at 12.45 and while it had not yet reached Bellingham Hill it was rapidly encircling the Garden Cemetery on both sides. The fire was beyond control. From then on, it was a continual falling back by the fighters on the flanks, to Marlboro and Sixth Streets, and finally to the railroad gap on the north; and to Third, Congress, Essex and Suffolk Streets on the south. The fire extended so rapidly that many of the buildings in the residential section burned without any effort being made to save them. The

extreme easterly section was sparsely covered and it was hoped for this reason that the specially hazardous buildings on lower Marginal Street and Eastern Avenue could be saved. The shower of sparks, pieces of wood, parts of buildings and the contents, all blazing, were carried by the wind far ahead. They settled down on the manufacturing plants, oil plants and East Boston buildings setting fire wherever they struck. Six Boston engines and the fire boat fell back on the East Boston shore and succeeded in putting out many roof fires. The Valvoline Oil Works in Chelsea caught about 1 o'clock. This plant contained kerosene oil, naphtha and machine oils; several explosions took place. The Stickney Tirrell Co. burned about 2 o'clock and the

Fig. 5. View in Marginal St. opposite Magee Furnace Co. showing smoke from oil plants

Tide Water Oil Co. about 2.30. Soon one of the tanks belonging to the latter company exploded, throwing a shower of burning oil over to the East Boston side of the trolley and railroad bridges and the Metropolitan Sewerage Pumping Station. These immediately took fire.

In the meantime, a creosote oil barge near Green's ship yard and the Samuel Cabot Co. factory became ignited. The burning oil passed under the wharf of the Samuel Cabot Co. Works and ignited it but the factory already had caught at the front, about 2 o'clock, from flying embers. Chelsea Creek was now covered with burning oil which was carried by an incoming tide up to the bridges and over to the wharves of the Standard Oil Co. on the East Boston side. The fire boat was hemmed in by burning oil but passed through it by directing its streams on the oil and making a passage for itself. The main buildings of the Standard Oil Co. caught from its wharves about 6 P. M. and were totally destroyed.

Fig. 6. View from Meridian St. Bridge, looking east, about 6 P. M.

Thus in seven hours a stretch of land a mile and a half long and half a mile wide had been completely burned over.

On the whole, the fire seems to have been fairly well fought especially in certain sections. It is not strange that under the stress and excitement of a large conflagration that many mistakes were made. If the entire energies of the department had been transferred to Lewitsky's rag shop after it was discovered to be on fire the results might have been different, for the Blacking factory was so isolated that the fire there could hardly have menaced the city as a whole. A better trained and better managed department would have undoubtedly prevented much damage and might have saved the city in the early stages of the fire; but no department could probably have prevented the fire spreading to the water front after it had once attained the proportions of a conflagration.

Details of the Chelsea Water Supply

Chelsea is in the Metropolitan water district, receiving its water from the same source as does Boston. The city owns and maintains its own mains, the Metropolitan water being delivered into their system through several connections, some of which are ordinarily kept shut.

The system is divided into two levels, a high and a low, the former supplying mostly the residential district in the easterly part of the city. There is a high service reservoir, capacity one million gallons, kept full by automatic valves from a sixteen-inch pipe, supplied by the Metropolitan twenty-inch main, entering the city by the north. This reservoir was formerly kept full by pumps located near the centre of the city draughting from the low service, but this station had not been used for several years and it was destroyed by the fire. Pressures on the high service system run from fifteen to seventy-five pounds.

The low service district includes about two-thirds of the city. It is supplied directly from the Metropolitan feeders at a pressure averaging about fifty pounds. A forty-two-inch main enters the city from the northwest and connects to the Chelsea mains near the city line and also in Broadway. The first connection is ordinarily kept closed. The Broadway connection is through a ten-inch Venturi meter with an extra twenty-inch connection kept shut off. Water also is available from closed connections in Marginal Street and a connection from the twenty-inch main to Charlestown; but ordinarily, to equalize the pressures, the current of water is from Chelsea into Charlestown. During

the heavy draught of this fire, however, this current was reversed and Chelsea was fed also from Charlestown through the twenty-inch main supplied farther back by twenty-four and thirty-inch pipes. No water is available from East Boston, the current in their mains being always from Chelsea.

There are also four connections between the high and low services which are ordinarily kept shut.

Early in the fire, as an extra precaution, the Superintendent of the Water Works opened the twelve-inch valve in the connection from the forty-two-inch Metropolitan main near the city line on the northwest. This was not long after 11 o'clock. He then opened the sixteen-inch valve near the reservoir, letting the Metropolitan high service directly into the Chelsea high service. He shut off the reservoir thinking that it might overflow, as normally the Metropolitan high service gives thirty pounds at the reservoir level. The eight-inch valve in Broadway separating the high from the low and also a similar six-inch valve, corner of Crescent Avenue and Washington Avenue were opened. Thus early in the fire, the Chelsea mains were well supplied, the high and low services working together and both backed up by liberal sized Metropolitan mains. The officials of the Metropolitan Board were in touch with the conditions and by 2 o'clock had opened the connection in Broadway letting in the full capacity of the twenty-inch main from Charlestown. The twenty-four-inch connection to the East Boston supplies was also opened.

The records of the Metropolitan Water Board show that the pressure in their main feeders in Chelsea did not drop more than twenty pounds below normal during the fire. We also find that no steamers in East Boston were in distress for lack of water and East Boston is entirely supplied from Chelsea. Any shortage of water occurring must have been due entirely to the heavy draught placed on the Chelsea pipes. We find a few cases where a steamer was temporarily unable to obtain water and several engineers report that the flexible suctions had to be replaced with stiff ones, the water being taken under a slight lift. Occasionally, steamers raced or were otherwise troubled with air in the suction but these cases are probably due entirely to local conditions. Steamers located on the principal streets found the supply adequate although the waste must have been large. The Chief Engineer of the Metropolitan Water Board estimates the consumption of water during the fire to be about twenty million gallons. This estimate is based on the pump and meter records.

In general, good judgment was shown by those in charge of the water supplies. There was no need of shutting off the reservoir as the demand for water was so great that it could not have overflowed but as this would probably have made no difference in the final result, this error of judgment is not important.

Fig. 7. General view of Bellingham Hill showing ruins of Highland School

Report of National Board of Fire Underwriters

In November, 1906, the National Board of Fire Underwriters issued a report on the City of Chelsea. This report dealt in detail with the usual features covered by these reports but did not dwell particularly on the "rag district" which proved to be so serious a feature. Their recommendations covered improvements in water supplies, fire alarm system, fire department auxiliaries, building ordinances, care of explosives and inflammables, and electrical installations. Under Conflagration Hazard, the Board suggested:

"66. That prompt measures be taken to relieve hazardous conditions in narrow streets by widening the streets, by enforcing adequate window protection, or by combining both methods.

67. That automatic sprinkler equipments be required in all buildings which, by reason of their size, construction or occupancy, singly or combined, might act as conflagration breeders."

None of the recommendations had, apparently, been complied with although both the Water Department and Fire Department had asked the City Government for appropriation to carry out certain improvements.

Sprinklered Buildings

There were only two sprinklered plants that were in the direct path of the conflagration and both were practically destroyed.

The sprinklered box shop of the WALTON & LOGAN CO. on Spruce Street, corner Beach Street was somewhat scorched on the front side but no sprinklers were opened. The exposure was principally from a one-story frame livery stable across the street, about fifty feet distant at nearest point and the wind was such that it carried the heat almost directly away from the box factory.

The W. A. SNOW IRON CO. was located on W. Third Street, near Spruce Street, on the westerly edge of the burned district. The main building was two stories, brick about forty-two by one hundred feet, with open joisted floors and roofs. At the rear was a one-story addition about sixteen by forty-two cut off with fair two-inch fire door and used for boiler room. At the rear of the main building were several one-story frame buildings used for forge shop, iron storage, etc. They were two to forty feet from main building and not sprinklered. There were also several other frame buildings nearby. The main building was equipped with Walworth sprinklers, one supply, fed by four-inch connection from six-inch street main. There was a low vacant space under building not sprinklered. There was no watchman or alarm service. The unsprinklered frame buildings at the rear apparently caught first, thus causing a hot fire which exposed the rear end of the main building. One of the East Boston engines was located on Third Street near this plant and the District Chief stated that the

Fig. 8. Ruins of Snow Iron Works Plant

box cornice caught fire first and that he was unable to get a stream on it on account of the wind and the difficulty of approaching the rear of the building. The fire worked in from the cornice and burned off the roof timbers, letting the roof fall and carrying the sprinkler piping with it. The roof of the Boiler House did not fall and some of the joists are not charred, which showed that sprinklers were of some effect. The building was practically destroyed although there is some woodwork left that shows the effect of the water from the sprinklers. A frame shed ten feet west and a frame tenement forty feet east of the building were saved. It would seem that with even a little assistance from the Fire Department, this building should have been saved. The insurance on this plant was $23,900. Loss settled for $23,000.

THE AMERICAN CIRCULAR LOOM CO. was located at the corner of Suffolk Street and Highland Avenue on the southeasterly edge of the burned area. The main building was three stories, about ninety by ninety. About one-third was brick with plank and timber floors and roofs, the remainder being wood open joist construction and having a Mansard roof with attic. There was also a two-story brick machine shop and storehouse about one hundred and twenty by forty, located thirty-five feet north of main shop. This latter building had no sprinklers. The main building was equipped with Grinnell Glass Disc sprinklers supplied by six-inch pipe from six-inch city main and a ten thousand gallon gravity tank on brick tower, bottom twelve feet above sprinklers. There was an alarm valve and standard watchman's

Fig. 9. Ruins of American Circular Loom Plant, from the south. Sprinkler tank was on top of brick tower

service. The exposure was light in the rear but across the street on the side from which the conflagration approached, there was a three-story wood tenement block, a three-story wood curry shop and also various wood dwellings and sheds. The curry shop became ignited from sparks before 1 o'clock, much in advance of the main line of fire, and burned rapidly setting fire to the tenement block which in turn ignited the Circular Loom Co. Fire first caught on the sprinkler tank house and wood cornices and worked into main roof. Several employees fought the fire with chemicals and small hose but without effect. Sprinklers opened properly but the tank was quickly drained and city pressure at that time and place was insufficient to supply the upper lines. No hose streams were available and the risk therefore quickly burned. The unsprinklered building burned afterward. The loss is practically total, the only portions standing being the brick elevator tower and the boiler room.

Insurance Building and Contents . .	$169,000.
Insurance U. & O.	75,000.

The loss on building and contents has been settled as a total loss but that on U. & O. has not yet been adjusted.

THE MAGEE FURNACE CO. This is a large brick and frame foundry plant valued at about a half million of dollars. It is located on Marginal Street south of the burned area. The conflagration came within three hundred feet of the property. There is a complete sprinkler system fed by city water and a fire pump. On the approach of the fire, the shutters on the brick buildings were closed with the assistance of representatives from this Bureau, and the roof kept wet down by streams from the fire pump.

The pump was kept running nearly all the afternoon and pressure was maintained on sprinkler system.

After the fire, we found two of the three six-inch sprinkler supplies from the city water shut off in the street. These were shut off by the order of the Water Works Superintendent, probably between 5 and 6 P. M. when the conflagration was still uncontrolled and was threatening the plant. The Superintendent is entirely frank and states that in his judgment his action was proper, he evidently concluding that the plant was going to burn anyway and that he might as well save a waste of water by shutting off the sprinklers beforehand. However absurd such a point of view may appear to well informed fire protection engineers, still in the light of this and other recent experiences, it would appear that, at least for some years, this attitude of the officials must be taken into account when considering sprinklered risks.

This Superintendent is a good water works man and his action can only be explained by pointing out that of late the general tendency of water works officials is toward requiring meters in fire pipes, limiting the size of sprinkler connections to four-inch and a general prejudice against sprinklers as a form of fire protection.

B. FEINBERG & SONS' rag shop, located on Fifth Street near Spruce Street was a three-story frame building. This was being equipped with sprinklers but the water supply had not been turned on. This plant was completely destroyed.

THE CHELSEA CORDAGE plant at the northwest edge of the fire area consisted of a two-story brick building of good mill construction with some frame out buildings. The property had been idle for several years and in October last a fire destroyed part of the frame buildings and damaged the main building. Most of the plant was

originally equipped with sprinklers but these had not been in commission since the last fire. The fire here is said to have caught late in the day in the frame section and worked back against the wind into the main building. This plant was well isolated and not in the direct path of the conflagration. It might easily have been saved had there been a hose stream there at the right time. It was not insured.

THE W. Y. RUSSELL & SON CO. building, close to the railroad, off Matthews Street, was formerly partially sprinklered but the equipment was not in use. This was completely destroyed.

General Remarks and Data on Other Buildings

The fire reached conflagration proportions very quickly and as quickly subsided. As the buildings were comparatively low and the wind strong, the hot gases and flame were held close to the ground burning everything in the direct path. For this reason, very little of a combustible nature is left. Especially is this true in the mercantile and dwelling section. Twelve hours after the fire started there was scarcely anything left burning in the fire area. Except in a few special cases, buildings, both brick and frame easily succumbed. In passing Broadway, the conflagration has been likened to a blow pipe flame, the wind causing this effect by sweeping through the buildings on fire and forcing the flames far in advance. The temperature of the conflagration wave probably did not reach much above fifteen hundred to two thousand degrees. In the oil works and lamp-black factory this figure was considerably exceeded, bricks in the walls having been fused. There was but little stone work in the district but the granite curb stones were badly spalled on many streets.

Only a few buildings directly in the path of the flames escaped. This was probably due to the protection afforded by other buildings, or to chance. Two small buildings on either side of the Snow Iron Works escaped, also a corrugated iron oil house and the wooden pest house at the extreme easterly end of the burned district.

SAMUEL CABOT CO.'S lampblack and stain factory furnishes more interesting data than any other building in the district as some effort had been made to protect it against fire. It was completely burned out but practically all the brick walls are standing, showing good construction. Many of the roofs were of hollow tile, supported

by steel beams spaced one foot on centre but unprotected. Where there was heavy fire, the roofs fell owing to the collapse of the beams but those buildings in which there was little combustible material stood up well. There were some fair tin covered shutters on part of the buildings. Some of them were completely destroyed but two which were barred closed, stood the test well, although the wood inside the shutters was practically all destroyed. There was also a one-eighth-inch iron door reinforced with strips at the edges. It was badly warped, one corner being at least two feet out of true. The yard contained many tanks of creosote, benzol and coal tar pitch. All the tanks which had wooden covers soon took fire. Some of the benzol tanks had heavy iron roofs with a man-hole cemented closed. The

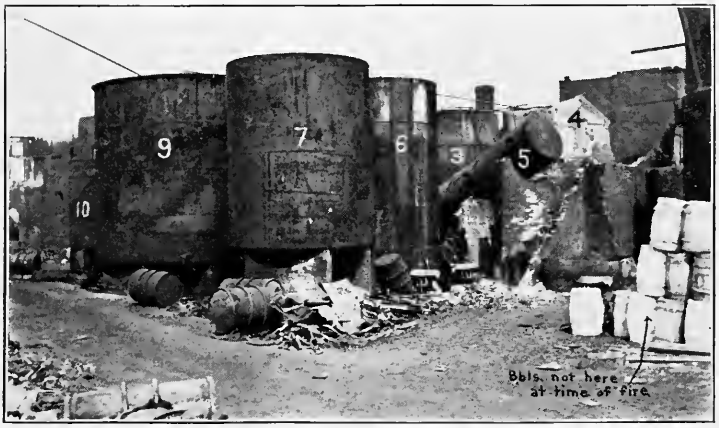


Fig. 10. Westerly group of tanks at plant of Samuel Cabot Co.

covers were blown off and the contents burned like a torch. There was no explosion in any case and the tanks are mostly in good condition. There were a large number of full benzol drums in the yard. The sides of these are bulged and cracked, and the contents burned. Some

of the benzol tanks between these drums and two large benzol tanks at the east end of the yard were not burned. Tanks which stood on wharves and bulkheads supported by wooden piles toppled over. Those on concrete and brick piers remained in position. The concrete piers withstood the heat with little damage. Photograph shows the west group of tanks as they appeared after the fire. The numbers correspond to the numbers on ground plan and tables. Further data in regard to the tanks is given in the following tables.

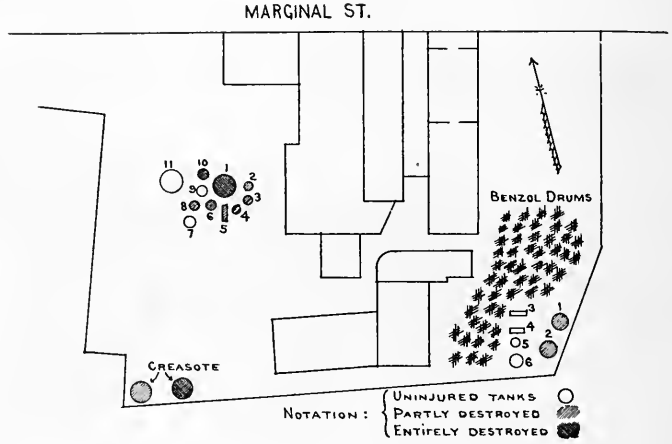


Fig. 11. Sketch of Samuel Cabot Co. Plant, showing location of tanks

Tanks in Yard of Samuel Cabot Co.

WEST GROUP.

	Cap. bbls.	Conts.	Amt. before fire.	Condition after fire.
1	1600	Creosote	1200	Contents completely destroyed. Tank melted to within 3 ft. of bottom.
2	350	Creosote		70 bbls. left; tank in good condition.
3	350	Benzol	full	140 bbls. left; tank in good condition.
4	240	Creosote	90	Contents completely destroyed. Tank melted around the top.
5	65	Creosote	full	Contents burned; tank on brick piers, one of which gave way.
6	350	Benzol	full	100 bbls. left. Tank in good condition.
7	Not used			Not burned.
8	110	Coal tar pitch	full	40 bbls. left. Tank in good condition.
9	630	Coal tar pitch	unknown	Not burned.
10	110	Coal tar pitch	30	All burned.
11	Very large	Creosote		Not burned.

EAST GROUP.

1	500	Crude benzol	nearly full	Contents all burned.	Tank in fair condition.
2	500	Crude benzol	nearly full	Contents all burned.	Tank in fair condition.
3	70	Light naphtha from coal tar; called red naphtha.		All partly full.	Not burned at all.
4	100	90% benzol	Refined benzol	All partly full	Not burned at all.
5	120	90% benzol			
6	350	1st distilate benzol			

Fig. 12. View of Valvoline Oil Co. Plant, showing remains of tanks and position of wall "A"

THE VALVOLINE OIL CO. was the worst damaged of any of the oil works. There were several buildings, partly brick and wood covering the oil tanks, in which was stored naphtha, kerosene oil and various machine oils in large quantities. Many of these tanks had no covers and the contents easily ignited as soon as the buildings were on fire. The naphtha was in covered horizontal tanks. Very soon these exploded and great havoc was created. Half of one of the tanks was hurled a hundred feet away and the remainder of it was forced into a nearby tank crumpling it up like so much tissue paper and throwing the contents all around the yard. The heat was intense. Some of the tanks were melted and many of the bricks on one wall of the building fused.

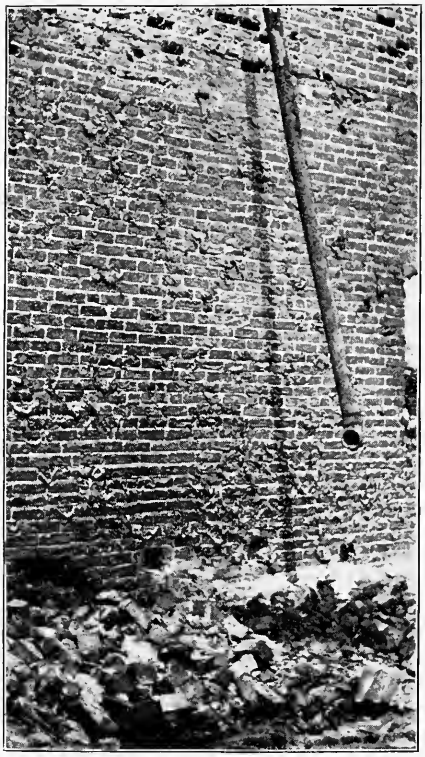


Fig. 13. Brick wall "A" at Valvoline Oil Co. Plant, showing fused bricks

THE TIDEWATER OIL CO. also fared badly. Some of the tanks stood in buildings and others on the wharf. Only one out of six or eight is in good condition.

Insurance Loss

It is estimated that the total insurance loss is about $9,000,000.

The following table shows the net losses sustained by the various companies, as reported officially to the Massachusetts insurance department, together with Massachusetts fire premiums for 1907 and surplus to policy holders. The figures marked thus * are not official returns but were compiled by the Standard Publishing Co. of Boston.

Name of Company	Net Loss at Chelsea	Fire Premiums in Mass. in 1907	Surplus to Policy Holders Jan 1, 1908
Aachen & Munich	$31,650	$49,544	$844,645
Adirondack	19,200	7,743	281,603
Etna	153,620	336,010	7,754,606
Agricultural	75,000	90,597	1,011,617
Albany	5,200	40,741	520,753
Alliance, Eng.	*35,000	Retired	.....
Alliance, Pa.	3,125	55,305	697,031
American, N. J.	45,045	95,223	2,351,615
American Central	214,386	147,300	2,830,877
American Lloyds	4,000	28,048	552,336
Assurance	13,150	4,125	266,557
Atlas	11,000	68,652	587,590
Ben Franklin	5,454	20,470	370,258
Boston	104,415	202,673	3,371,760
British America, Can.	11,100	37,139	481,771
Buffalo Commercial	26,391	16,416	335,123
Buffalo German	75,000	32,571	1,700,800
Caledonian	47,100	101,575	466,658
Caledonian American	1,540	8,443	225,099
Calumet	200	14,534	366,747
Camden	14,917	71,692	691,791
Capital	30,515	53,534	331,361
Citizens, Mo.	11,851	47,687	343,339
City of New York	49,000	22,440	357,704
Cologne	9,101	58,158	178,581
Columbia (Marine)	225	9,306	497,610
Commerce	3,500	23,911	366,658
Commercial Union, Eng.	45,000	169,352	1,885,166
Commercial Union, N. Y.	1,000	26,674	286,551
Commonwealth	5,250	44,373	1,163,727
Concordia	29,125	39,038	490,620
Connecticut	101,519	137,897	2,118,394
Continental	146,441	229,519	8,503,591
Cosmopolitan	5,000	26,830	353,303
County, Pa.	14,400	43,885	561,940
Delaware, Pa.	56,309	56,641	541,724
Detroit F. & M.	14,200	44,586	1,339,408
Dixie	7,050	23,349	663,622
Dutchess	5,225	25,911	245,173
Eastern, N. J.	3,225	19,735	289,547
Empire City	19,552	28,092	316,931
Equitable	11,100	71,259	484,437

Farmers, Pa.	82,000	71,725	488,712
Fidelity	29,937	56,383	1,801,676
Fire Association, Pa.	95,852	217,510	2,554,022
Firemans Fund	91,825	115,692	2,406,922
Firemens, N. J.	75,000	105,786	3,166,304
Franklin, Pa.	46,332	54,936	815,750
German Alliance	5,765	31,645	744,591
German American, Md.	272	13,075	356,188
German American, N. Y.	198,585	266,165	5,915,353
German, Peoria	8,500	12,455	335,121
German, Pitts.	44,117	50,963	523,246
Germania	165,785	106,057	1,949,261
Girard	8,000	48,562	805,710
Glens Falls	65,900	58,348	2,280,893
Granite State	12,250	67,091	443,693
Hamburg Bremen	33,345	71,365	392,048
Hanover	215,000	99,043	1,854,091
Hartford	276,170	377,760	5,261,450
Home, N. Y.	250,600	406,410	10,203,211
Ins. Co. of N. A.	160,040	321,637	4,067,941
Ins. Co. State of Pa.	2,917	36,060	358,805
Jefferson	44,685	59,432	365,886
Law Union & Crown	1,000	10,760	250,726
Liv. & Lon. & Globe, Eng.	98,350	374,428	4,421,815
London	100,000	100,147	618,474
London & Lancashire	81,410	125,342	783,636
Lumber	16,800	9,389	311,035
Mechanics	2,250	21,276	498,479
Mechanics & Traders	14,074	23,949	565,498
Mercantile	22,071	29,900	217,906
Michigan Commercial	3,000	51,516	410,393
Milwaukee	1,250	6,927	342,932
Milwaukee Mechanics	20,100	38,515	1,047,171
Munich	12,276	286,391	745,594
Nassau	13,950	40,690	235,406
National, Conn.	69,375	209,627	2,503,661
National, Pa.	1,000	26,746	961,154
National Lumber	200	7,031	235,233
National Union	147,900	72,821	1,023,746
Newark	4,800	15,191	603,994
New Brunswick	10,000	5,531	256,833
New Hampshire	67,489	163,155	2,422,978
Niagara	244,698	254,512	1,535,091
North B. & M., Eng.	71,786	235,460	2,698,689
North B. & M., N. Y.	3,130	33,038	696,263
Northern, Eng.	150,861	127,877	1,190,900
Northern, N. Y.	5,037	41,171	453,542
North River	83,295	90,635	580,059
Northwestern National	32,000	36,415	2,154,186
Norwich Union	302,234	104,894	538,461
Ohio German	200	.....	260,192
Old Colony	1,250	44,554	510,884
Orient	95,700	63,918	879,824
Pacific	*1,000	.....	388,474
Palatine	73,600	159,238	1,049,546
Pelican	5,050	11,015	284,695
Pennsylvania	100,000	186,813	2,365,284
Peter Cooper	*750	.....	211,899
Phenix, N. Y.	216,500	178,048	2,449,462
Phœnix, Conn.	230,935	228,076	3,421,848
Phœnix, Eng.	51,476	103,672	993,151

Providence Washington	51,025	130,402	720,550
Prussian National	49,500	48,786	600,842
Queen	112,550	164,538	2,961,539
Reliance	10,000	41,691	488,425
Rhode Island	100	18,069	602,723
Richmond	1,725	5,047	246,043
Rochester German	46,938	83,520	1,074,824
Rossia	34,806	117,758	389,576
Royal	342,500	423,186	3,094,131
Royal Exchange	82,057	73,094	926,643
St. Paul	110,000	73,247	1,126,653
Salamandra	27,450	107,801	314,875
Scottish U. & Nat'l	29,150	92,419	2,347,685
Security, Conn.	18,500	72,123	762,754
Shawnee	55,000	49,506	404,539
Skandia	6,750	59,441	181,956
Southern, La.	5,000	22,743	292,974
Springfield	109,850	215,752	2,910,588
Spring Garden	32,425	78,953	546,324
Stuyvesant	1,000	.....	264,166
Sun	91,766	167,657	1,051,988
Svea	29,450	19,318	439,525
Teutonia, La.	8,075	43,749	375,076
Union, Eng.	16,900	Retired	.....
Union, N. Y.	19,516	24,430	280,978
Union, Pa.	15,540	39,890	275,000
United Firemens	360,085	58,975	188,677
United States	*750	.....	288,417
United States Lloyds (Marine)	*10,000	58,750	963,960
Virginia F. & M.	1,500	30,542	634,662
Westchester	165,033	105,758	1,207,460
Western, Can.	114,450	63,996	584,136
Western, Pa.	10,049	31,970	436,030
Western Reserve	1,500	15,874	313,255
Williamsburg City	33,300	57,029	705,686
Winona	580	12,569	361,734

MUTUAL COMPANIES.

Abington	4,600	44,490	66,044
Berkshire	4,900	46,390	64,738
Cambridge	68,522	68,263	37,337
Citizens	199,670	85,630	143,890
Dedham	9,400	39,518	101,609
Dorchester	59,150	176,641	80,286
Fitchburg	20,525	77,697	45,576
Hingham	29,550	112,378	97,332
Holyoke	113,950	133,475	670,933
India	2,750	26,724	189,906
Lowell	50,000	68,287	126,363
Merchants & Farmers	35,250	65,588	104,304
Merrimack	67,725	98,255	62,623
Middlesex, Mass.	65,000	175,950	334,366
Mutual Protection	16,150	40,850	62,521
Norfolk	30,000	89,821	449,330
Pawtucket	11,500	42,167	244,900
Providence	3,300	13,855	417,495
Quincy	74,500	117,893	530,809
Salem	5,862	43,541	38,051
Traders & Mechanics	140,000	136,280	327,018
Worcester	75,000	134,104	554,366

The stock insurance companies met this great loss without serious impairment of their capital. The United Firemen's of Philadelphia suffered severely but steps were taken at once to reduce the capital of the company and meet all obligations. Several dwelling house Mutuals lost heavily and at least three will be forced partially or entirely out of business. The Citizens of Boston has already reinsured about three-quarters of its business in the Royal and the Merrimac of Andover reinsured about $5,000,000 of its liability in the Traders & Mechanics. The Cambridge Mutual has reinsured its entire business in the Royal and will retire from business.

Adjustments are being made with commendable rapidity and three weeks after the fire, very few losses remain unsettled. The larger companies at once opened offices in Chelsea where the adjusters were on hand as long as necessary. A very efficient bureau of information was opened by companies represented in the New England Insurance Exchange. This all goes to show the great strength of the larger stock insurance companies and their ability to withstand the heavy drain of any ordinary conflagration.

Conclusions

The most notable facts which this fire emphasizes are as follows:

1. The dangerous nature of pitch or mansard shingle roofs, frame porches, piazzas and accessory woodwork in spreading a conflagration.

2. The complete failure of any roof supported by unprotected steel or iron to withstand any but the smallest fire.

3. The need of good window protection where the sweep of the flames is parallel to division walls and the necessity of blank walls or properly protected window openings and parapet walls at right angles to prevailing winds.

4. The vulnerability of any ordinary buildings to sparks and embers, provided the bombardment be long enough, even though the space separating them from the burning buildings is great.

5. The slight value of streets of ordinary widths in holding a fire when there is strong wind blowing and the fighting force is scattered.

6. That the safest way to store oil in large quantities is in well made boiler iron riveted tanks having covers of the same material with large automatic relief valve, all well supported on brick or concrete piers.

7. That Municipalities cannot violate the laws of good construction and fire protection without inviting conflagration.

8. That the Metropolitan Water Works system is shown to be exceedingly valuable for cities which it serves as it successfully withstood the extraordinary draught caused by this conflagration, although the Chelsea mains were not adequate in size nor properly gridironed.

9. That more co-operation is needed between city officials and insurance interests in regard to protection against fire.

Chelsea cannot be considered blameless for this conflagration. The officials fully realized the conditions. Both water board and fire department had asked for improvements but the Aldermen refused to grant appropriations. Fire protection that is originally ample should keep pace with changed conditions in cities and almost invariably cities fail to recognize these changed conditions. In the case of Chelsea, however, it proved to be not so much defective water works and fire department as inadequate building laws poorly enforced, and the admittance of an irresponsible foreign population supposed to be favorably inclined to incendiarism.

The attitude adopted by water boards, not only of Chelsea but of other cities, should not be passed over. We refer to the constant combating of advanced fire protection ideas affecting private fire service pipe, and the requiring of meters on fire service connections, thus discouraging automatic sprinkler protection. Economy in the use of water is their one cry and they bend every effort in that direction. No argument is necessary beyond pointing out our enormous annual fire losses to show both the weakness of their position and the falseness of their economy. It is the insurance companies who pay the bills in case of a conflagration and it is the duty of officials to recognize and follow the rules and suggestions made by fire protection engineers who are impartially endeavoring to decrease the fire waste of the country. Automatic sprinklers are well known to be the cheapest method of extinguishing fires and in ninety-three per cent. of the cases they are successful. Any policy of water works officials which discourages sprinkler equipments should be strongly condemned.

Recommendations Pertaining to the Rebuilding of Chelsea

1. Set apart a certain section of Chelsea as a "rag district" and segregate all rag shops in this section. Formulate a special code of building laws for application to this district dealing particularly with types of buildings, distances apart, height, partiwalls, cornices, roofs, areas, window protection and making compulsory the installation of automatic sprinklers where area is over a certain amount.

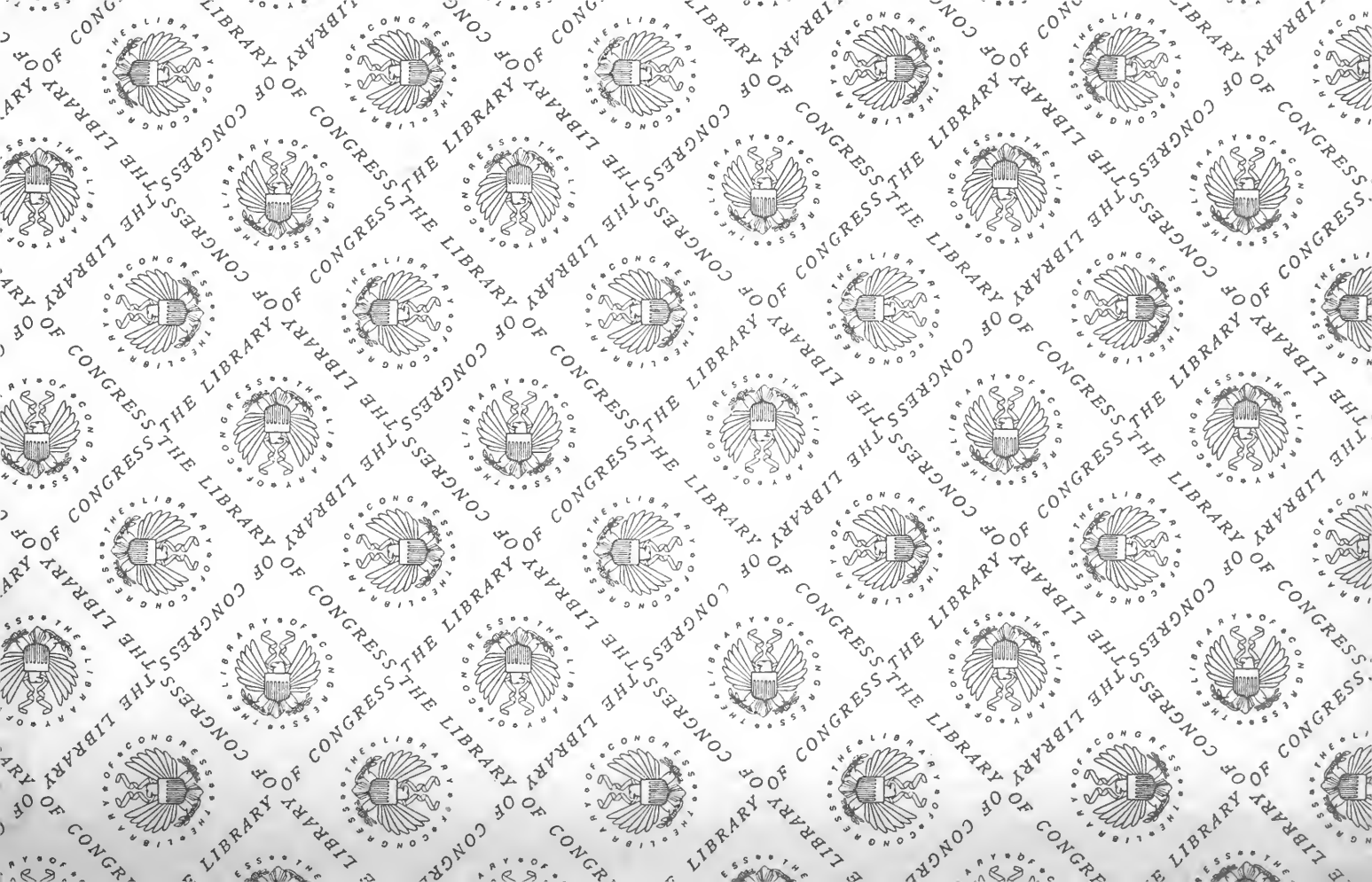
2. Require licenses for all rag shops and formulate rules regulating the rag shop business, also provide for regular inspection with power to revoke licenses.

3. Enlarge present fire limits and revise building laws in the light of modern fire protection.

4. Require that all buildings on both east and west sides of Broadway shall have self sustaining rear walls of brick or equally good fireproof material of proper thickness parapeted above roof; or provided with fireproof cornice. All floor and roof timbers to be self releasing. Limit the number of openings and require all openings to have standard fire shutters.

5. Gridiron principal mains in east and west section; remove all four-inch pipe and require water works department to adopt a more favorable attitude toward sprinkler equipments.

6. Establish a new engine company in the "rag district."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